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Predicting Revision Following In Situ Ulnar Nerve Decompression for Patients With Idiopathic Cubital Tunnel Syndrome.

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ABSTRACT

PURPOSE

To determine the incidence of revision and potential risk factors for needing revision surgery following in situ ulnar nerve decompression for patients with idiopathic cubital tunnel syndrome (CuTS).

METHODS

We conducted a retrospective chart review of all patients treated at one specialty hand center with an open in situ ulnar nerve decompression for idiopathic CuTS from January 2006 through December 2010. Revision incidence was determined by identifying patients who underwent additional surgeries for recurrent or persistent ulnar nerve symptoms. Bivariate analysis was performed to determine which variables had a significant influence on the need for revision surgery.

RESULTS

Revision surgery was required in 3.2% (7 of 216) of all cases. Age of less than 50 years at the time of index decompression was the lone significant predictor of need for revision surgery. Other patient factors, including sex, diabetes, smoking history, and worker compensation status were not predictive of the need for revision surgery. Disease-specific variables including nerve conduction velocities, McGowan grading, and predominant symptom type were also not predictive of revision.

CONCLUSIONS

For patients with idiopathic cubital tunnel syndrome, the risk of revision surgery following in situ ulnar nerve decompression is low. However, this risk was increased in patients who were younger than 50 years of age at the time of the index procedure. The findings of this study suggest that, in the absence of underlying elbow arthritis or prior elbow trauma, in situ ulnar nerve decompression is an effective, minimal-risk option for the initial surgical treatment of CuTS.

LEVEL OF EVIDENCE

Prognostic Level III

INTRODUCTION

Cubital tunnel syndrome (CuTS) is second only to carpal tunnel syndrome in incidence among compression neuropathies of the upper extremity. [1-3] Despite its commonality, there is no established consensus regarding the optimal surgical treatment. This is evidenced by a wide range of surgical options including in situ decompression, medial epicondylectomy and subcutaneous, intramuscular or submuscular transposition of the ulnar nerve. Additionally, in recent years surgeons have also advocated for endoscopic or minimal-incision release of the ulnar nerve, with or without transposition, to further minimize soft tissue trauma and potential vascular insult to the nerve, while allowing for faster recovery, thus further expanding the number of treatment options. [4-6]

Technique selection can depend on a variety of factors including surgeon preference, patient anatomy, patient desires, underlying pathology, and complication rates. Transposition, for example, often requires extensive dissection around the nerve, which may compromise its extrinsic vascular supply. Thus, it may be contraindicated in patients with diabetes for instance who may have a tenuous vascular system at the level of the cubital tunnel. [7, 8] In addition, with an increasing focus on healthcare economics in the United States, the relative cost-effectiveness of different treatment options for CuTS may progressively factor into surgical decision-making, thus potentially clouding the treatment decision even further. [9-11]

Generally, in situ decompression offers the least invasive surgical option but may increase the risk of revision surgery. [12, 13] A recent study found that prior history of trauma around the elbow was a notable predictor of need for revision after in situ decompression of the ulnar nerve, while other postulated factors including patient age had no effect. [14] However, risk factors for revision in patients with *idiopathic* CuTS, that is, those without an underlying traumatic, arthritic, or other pre-disposing etiology, remain unclear. As revision surgery yields inferior outcomes versus primary surgery for CuTS, information on risk factors leading to revision in these patients with idiopathic CuTS could provide a valuable addition to the overall treatment algorithm. [15]

The purpose of this study was to determine the incidence of needed revision after in situ ulnar nerve decompression for patients with idiopathic CuTS and to investigate which patient risk factor(s) may contribute to an increased likelihood of needing revision.

MATERIALS and METHODS

This study was approved by our institutional review board. Using our departmental electronic billing database search for Current Procedural Terminology (American Medical Association, Chicago, IL, USA) code 64718 (surgery on ulnar nerve at elbow), we identified all patients who had undergone in situ ulnar nerve decompression surgery from January 2006 through December 2010. Patients who demonstrated intraoperative subluxation of the ulnar nerve following in situ decompression were excluded, as these patients subsequently underwent either anterior transposition of the ulnar nerve or medial epicondylectomy. Patients were also excluded if they underwent in situ ulnar nerve decompression for reasons other than treatment of CuTS symptoms (e.g., prophylactic release performed in conjunction with elbow arthroplasty or fracture fixation) or had previously undergone operative treatment for CuTS. In addition, patients with a prior history of fracture or trauma at the elbow were excluded, as were those with a history of degenerative, post-traumatic, or inflammatory arthritis at the elbow. However, patients with a known history of inflammatory or systemic arthritis without evidence of local arthritic changes at the surgical elbow were not excluded. Finally, patients with less than 6 months of follow-up at our institution were excluded from data analysis unless a revision surgery occurred in that time interval. Records for those patients with less than 6 months of follow-up were reviewed in an effort to predict their clinical course. In addition, attempts were made to contact those patients via telephone with the goal of identifying any patients that may have had additional surgery performed elsewhere.

Diagnostic workup

Patients seen at our institution are generally evaluated by the treating surgeon prior to obtaining additional studies, including imaging or electrodiagnostic testing. Exceptions to this practice typically only occur in patients who are seen at our institution for a second opinion and have already undergone electrodiagnostic testing prior to presentation. During initial evaluation, a comprehensive clinical examination, including disease-specific tests and provocative maneuvers, is performed. This includes 2 point-discrimination, vibratory discrimination testing, comparative grip strength testing, cross-finger testing, Froment sign, Tinel sign, elbow flexion-compression test, and testing for nerve mobility. When a patient is suspected of having CuTS based on clinical history and physical examination, standard elbow radiographs are routinely obtained to rule out contributory bony abnormalities or deformities in addition to electrodiagnostic testing. Nerve conduction tests are considered abnormal if conduction velocity across the affected elbow is less than 50 meters per second or is decreased by more than 10 meters per second across the elbow . The diagnosis of CuTS is based on clinical findings in conjunction with nerve testing results.

Additionally, effort is made to elucidate any nerve symptoms not originating at the elbow, such as proximally based cervical pathology or distal compression of the ulnar and median nerves at the wrist. When the diagnostic workup suggests pathology at those distal sites, it is not uncommon in our practice to perform concomitant release of the ulnar and median nerves at the Guyon canal and the carpal tunnel. However, for those patients with findings of ipsilateral cervical radiculopathy, the cervical pathology is generally addressed prior to any operative management of CuTS-related symptoms.

Operative indications

Indications for primary in situ decompression generally involve nerve symptoms consistent with CuTS that have failed a trial of conservative management, have positive electrodiagnostic findings, and have a stable ulnar nerve. At our institution, ulnar nerve hypermobility, manifested as nerve subluxation or dislocation during preoperative or intraoperative assessment, is considered a contraindication to performing in situ decompression alone. Thus, when such hypermobility is noted, alternative surgical options such as anterior ulnar nerve transposition or medial epicondylectomy are considered.

The decision to operate on patients with CuTS in the revision setting is a joint-agreement between the patient and surgeon. Although this is normally approached on a case-by-case basis, the typical scenario involves persistent or incomplete-resolution of symptoms compared to preoperatively. Workup for recurrent or persistent CuTS is largely the same as in primary CuTS described above.

Surgical technique and postoperative protocol

All surgeries were performed by one of 8, fellowship-trained orthopedic hand surgeons. A posteromedial incision measuring 5 to 10 centimeters centered about the epicondylar groove is used for exposure. As the incision is carried subcutaneously, care is taken to identify and protect branches of the medial antebrachial cutaneous nerve. Upon identification of the ulnar nerve, decompression is performed via surgical release of the Osborne ligament and fascia overlying the flexor carpi ulnaris with blunt dissection carried roughly 8 centimeters proximally to the level of the arcade of Struther. In those patients found to have an anconeus epitrochlearis, the anomalous muscle is generally split or excised depending on its involvement in compression of the ulnar nerve. Care is taken to avoid circumferential dissection around the nerve to preserve its vascular supply. Following release, the elbow is taken through its full range-of-motion to confirm stability of the ulnar nerve. Postoperatively, the limb is placed in a well-padded posterior long-arm orthosis with the elbow positioned in approximately 70 degrees of flexion. Active range-of-motion is typically initiated subsequent to the first postoperative visit one week following surgery. Nerve conduction testing is not routinely performed postoperatively except in cases of persistent, recurrent, or worsening symptoms.

Data collection and statistical analysis

For those patients satisfying inclusion in the study, demographic, medical, and surgical data were obtained from departmental records. We defined our primary outcome of interest to be revision cubital tunnel surgery performed after in situ ulnar nerve decompression. Thus any patients, who at the time of data analysis had not had revision surgery, were designated to the control cohort. Bivariate analysis was performed for categorical variables of sex, diabetes history, smoking history, presence of bilateral symptoms, predominant preoperative symptom, modified pre- and postoperative modified McGowan grade, concomitant surgery, and worker compensation status using Chi-square or Fisher exact testing. Continuous variables recorded preoperatively including symptom duration, body mass index (BMI), and nerve conduction velocity (NCV), were compared using Student t-test or Mann-Whitney *U* test. Age was analyzed as both a categorical variable (less than 50 years versus greater-than-or-equal-to 50 years) and as a continuous variable.

<u>RESULTS</u>

A total of 216 elbows in 201 patients satisfied inclusion in this study. (See Figure 1) The mean age at the time of surgery for all 216 cases was 53 +/- 14 years, with mean follow-up duration of 22 +/- 21 months. Continuous and categorical demographic variables of the entire study cohort are represented in Tables 1 and 2, respectively.

Revision surgery was required in 7 (3.2%) cases, with the first revision occurring at a median interval of 10 months from the index surgery (range 3 to 59 months). Five of those patients were revised with anterior subcutaneous transposition, one with submuscular transposition, and one with intramuscular transposition. Two patients required more than one revision for persistent or recurrence of symptoms. Treatment course and demographic characteristics of those patients requiring revision surgery are outlined in Table 3.

Bivariate analysis

Younger age had a statistically significant effect on need for revision surgery when analyzed as a continuous variable, mean age non-revised = 53 +/- 14 years versus revised = 43 +/- 7 years; P = 0.009, (see Table 1) and as a categorical variable (age ≥

50 years vs. age < 50 years; Fisher exact test, $P = 0.002$, see Table 2). The duration of preoperative symptoms in the revised cohort was roughly double that of the controls, although this association only approached statistical significance (12 +/- 11 months versus 26 +/- 17 months; $P = 0.08$, Table 1). Patient sex, diabetes history, smoking history, predominant symptom at this time of surgery, modified McGowan grade, concomitant surgery, worker compensation status, body mass index, and ulnar nerve conduction velocity values were not statistically different between those patients requiring revision and those who did not. Figure 2 illustrates the change in modified McGowan grade for the entire study cohort. Tables 1 and 2 detail the respective relationships of continuous and categorical variables and the need for revision surgery.

Subjective and validated outcomes

No patients reported worsening of their symptoms following ulnar nerve in situ decompression compared to preoperatively. Of the 209 patients who did not undergo revision surgery, 3 patients complained of persistent sensory symptoms and were offered revision surgery, but they declined. A fourth patient reported recurrence of her symptoms and expressed desire to undergo revision surgery, but she was subsequently lost to follow-up. Multiple attempts to contact that patient via telephone were unsuccessful. The remaining 205 patients reported subjective improvement and general satisfaction following their operation. Table 3 details the treatment course of the revision cohort.

DISCUSSION

Selecting the optimal surgical treatment plan for patients with idiopathic cubital tunnel syndrome remains a difficult task. Though numerous studies have explored differences in outcomes among the various surgical options, results have often been inconclusive, and at times, contradictory. [3, 16-18]

Need for revision surgery is a particularly important outcome to investigate, as it not only represents a sub-optimal clinical result but has important economic considerations as well. With a lack of high quality, adequately powered prospective randomized-control trials comparing the multitude of surgical options for CuTS, cost-effectiveness and decision analyses may afford clinicians a useful tool for comparisons when real-world studies fall short or may simply be impractical. [9, 11, 19] A decision analysis study concluded that in situ decompression of the ulnar nerve had the highest utility of 4 tested surgical procedures, while medial epicondylectomy fared worst. [10] These results were later supported by Song et al, who explored the same four surgical treatments for CuTS and found that in situ decompression to be superior to the other options in cost-effectiveness. [11] Both studies used literature available at the time to account for expected incidences of complications and revision for each of the 4 surgical treatments examined. In a randomized-control trial comparing ulnar nerve in situ decompression with anterior subcutaneous transposition, Bartels et al found in situ decompression to be superior from a cost perspective, while also demonstrating a lower incidence of complications. [3, 9]

Despite the findings of these studies supporting in situ decompression as a first-option for CuTS, the question remains as to which patients are best suited for this versus other surgical options for CuTS, particularly in regards to circumventing the need for revision surgery. Determining which patients are most likely to need revision surgery after initial decompression could be equally as valuable as the previously mentioned cost and decision-based analyses in avoiding the medical and economic costs associated with a second surgery. Krogue and colleagues studied factors leading to revision after in situ ulnar nerve decompression for CuTS and found that a prior history of elbow trauma was the most notable variable predicting the need for revision surgery after simple decompression. [14] In light of those findings, we determined that further investigation into risk factors leading to revision for patients with idiopathic would provide additional information to surgeons contemplating surgical options for CuTS.

In this study, we report an overall revision incidence of 3.2%, which is lower than previous studies of in situ decompression. At least one potential factor for this difference is the exclusion of patients with traumatic or arthritic etiology. However, this is not completely unlike a previous study by Goldfarb et al, who excluded patients with elbow arthritis, medial epicondylitis, and ulnar nerve subluxation, and reported a revision incidence of 7%. [12] When Krogue et al implemented even less stringent inclusion criteria, they reported a revision incidence of 19%. [14] Taken together, these 3 studies suggest that, in the absence of both traumatic and arthritic conditions, simple in situ decompression of the ulnar nerve for CuTS has an low incidence of revision. A comparative overview of the these studies is included in Table 4.

Our study also provides statistically significant evidence that younger age is a risk factor for needing revision surgery in these patients. Although the clinical meanaing of this finding is less clear, the relationship of younger age as a pre-disposing factor to complications after in situ decompression is not novel. Murata et al demonstrated younger age to be predictive of increased incidence of ulnar nerve dislocation, as simulated intra-operatively by placing patients' elbows in full-flexion after ulnar nerve decompression. [20] Theysuggested that anatomical differences in the size of the medial epicondyle and the shape of the ulnar groove played a role in the higher nerve dislocation incidence in younger patients. All elbows in our study were confirmed to have a ulnar nerve that neither subluxed or dislocated when tested intra-operatively after release had been performed during the index procedure. However, of the 7 cases requiring revision, 4 were noted to have a subluxating ulnar nerve at the time of revision surgery. None of these 4 patients was noted to have nerve instability in their latest physical examination prior to undergoing revision. It remains unclear as to the mechanism by which a confirmed stable ulnar nerve would later become unstable without any further intervention. In addition, we were unable to account for the fact that these nerves appeared stable during examination and only after surgical re-exposure were they unstable. We speculate that perhaps some of the soft tissue and scarring that was released to gain exposure at the time of revision surgery may have also had a tethering effect on the nerve. Regardless of the means through which younger age predicts a higher revision incidence following in situ decompression for treatment of CuTS, these findings suggest a consideration for surgeons to discuss with younger patients seeking operative treatment for CuTS.

This study has limitations. Its retrospective nature required that we rely strictly on medical records, which were not always complete and could be subject to interpretation. In addition, though we only included patients who had at least 6 months of follow-up at our institution, there is potential for bias if any patients sought care involving revision surgery elsewhere after that initial period. We sought to minimize this possibility by attempting to reach patients via telephone while also reviewing records for those patients to predict which, if any, would be likely to seek care elsewhere. We were unable to contact over one-third of those patients with less than 6 months of follow-up (see Figure 1). Furthermore, relying solely on clinical documentation to speculate on this type of information is imperfect. Lastly, while our specific aim was to investigate risk factors specific to idiopathic CuTS, exclusion of patients with post-traumatic or arthritic etiologies may have led to us to underestimate a clinically relevant revision incidence.

Despite these limitations, our results may be useful in establishing a treatment algorithm for uncomplicated idiopathic CuTS. In particular, for patients confirmed to have CuTS without arthritis or history of trauma to the involved elbow, our findings strongly support in situ decompression as a reliable, first-line surgical treatment option. The risk of revision increased somewhat in patients younger than 50 years of age, though the underlying mechanism of this relationship remains unclear.

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FIGURES

Figure 1. Flow chart of inclusion and exclusion criteria applied to potential study subjects.

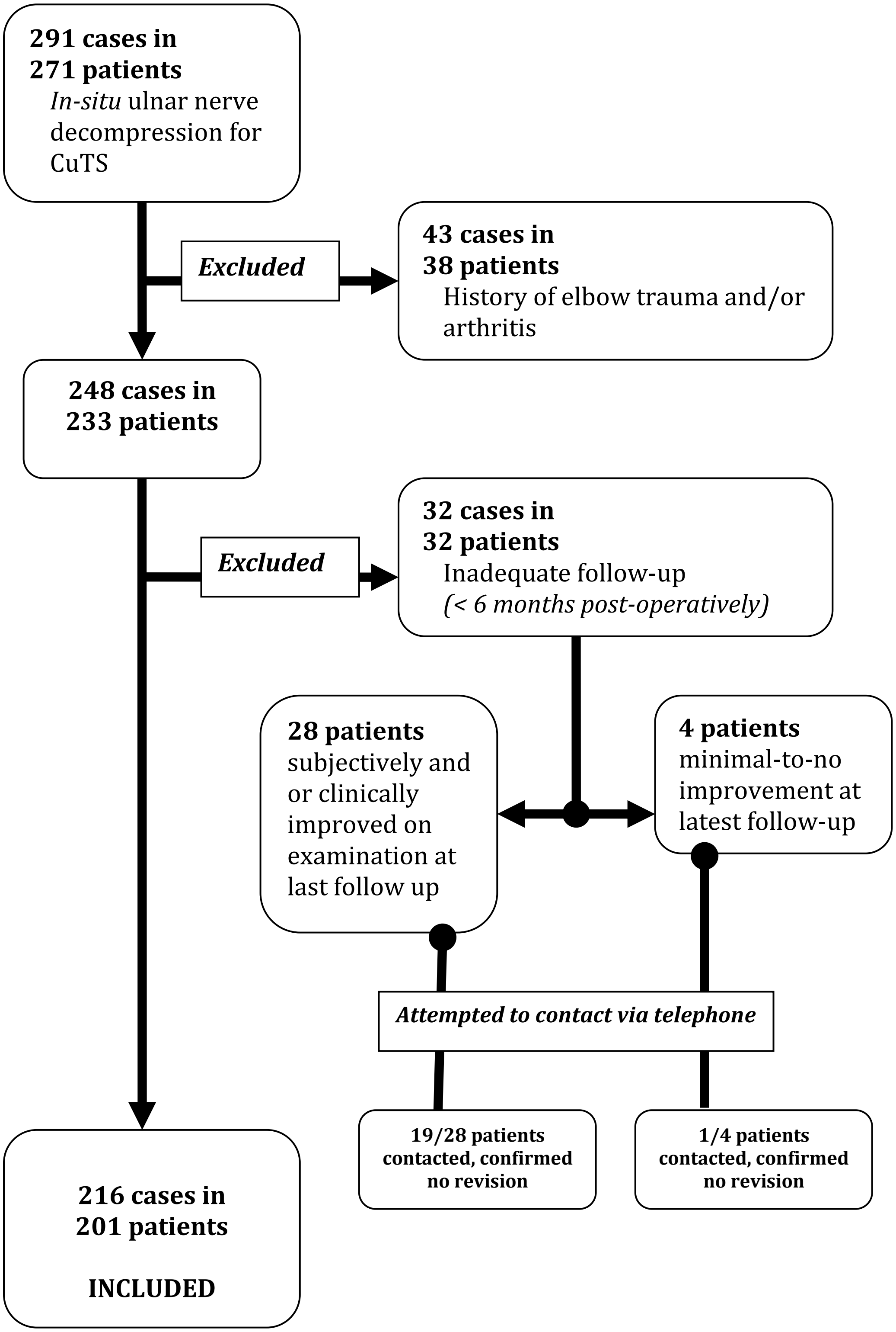

Figure 2. Graphical representation of change between pre- to postoperative Modified McGowan grade. Aside from 2 patients with preoperative grade of IIa who improved to normal postoperatively (thick dashed arrow), all other patients either improved by one grade (solid arrow) or remained the same (dotted arrow).